IGNITION SYSTEMS FOR INTERNAL COMBUSTION ENGINES

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Abstract of **CA 1049609 (A1)**

A closed loop electronic ignition system for internal combustion engines, in which a comparison is made between a signal derived from a fixed predetermined crank-shaft angle, and a signal derived from the commencement of the second stage of combustion within a cylinder of the engine, and if non-coincidence is detected between the two signals, the ignition timing is either advanced or retarded so as to maintain coincidence between the signals, so that the second stage of combustion always occurs at the fixed predetermined crank angle, the spark then being extinguished by switching the ignition coil "on" at this predetermined crank-shaft angle, irrespective of the speed and load on the engine, as well as all other parameters which can affect the ignition timing.

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(54) IGNITION SYSTEMS FOR INTERNAL COMBUSTION ENGINES

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No. OF CLAIMS 22

ABSTRACT OF THE DISCLOSURE

A closed loop electronic ignition system for internal combustion engines, in which a comparison is made between a signal derived from a fixed predetermined crank-shaft angle, and a signal derived from the commencement of the second stage of combustion within a cylinder of the engine, and if non-coincidence is detected between the two signals, the ignition timing is either advanced or retarded so as to maintain coincidence between the signals, so that the second stage of combustion always occurs at the fixed predetermined crank angle, the spark then being extinguished by switching the ignition coil "on" at this predetermined crank-shaft angle, irrespective of the speed and load on the engine, as well as all other parameters which can affect the ignition timing.

THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

1. An electronic ignition system for an internal combustion engine, including: means for sensing a pre-determined pressure on the pressure rise curve occurring during the second stage of combustion in a cylinder of an engine at each firing cycle; means for comparing the crank-shaft position at said pre-determined pressure with a fixed pre-determined crank-shaft position; and digital means for advancing or retarding the ignition by one step at a time so as to maintain this pre-determined crank-shaft position at said pre-determined pressure on the pressure rise curve occurring during the second stage of combustion, irrespective of engine requirements.

2. An electronic ignition system according to claim 1, wherein the means for sensing the pre-determined pressure on the pressure rise curve occurring during the second stage of the combustion process in the cylinder is an electro-mechanical transducer device, which is located in the wall of the cylinder, above the level of the top of the piston at T.D.C.

3. An electronic ignition system according to claim 2, wherein said electro-mechanical transducer device is a piezo-electric detector.

4. An electronic ignition system according to claim 1, wherein the means for sensing the pre-determined pressure on the pressure rise curve occurring during the second stage of the combustion process in the cylinder is an additional spark plug across which a low voltage supply is applied, means being provided for detecting the current flow across the gap of the spark plug, due to ionization of the fuel mixture on combustion.

5. An electronic ignition system according to claim 1, wherein said means for sensing the pre-determined pressure is means for sensing the commencement of the second stage of the combustion process in the cylinder, said means for sensing the commencement of the second stage of the combustion process in the cylinder being the combination of a translucent window located in the wall of the cylinder above the level of the top of the piston at T.D.C., a radiation sensitive device, and a fibre optic cable interconnecting the window and the radiation sensitive device, so as to sense the commencement of the second stage of combustion and, consequently, the pre-determined pressure occurring at the commencement of the second stage of combustion.

6. An electronic ignition system according to claim 5, wherein said translucent window is made of quartz glass.

7. An electronic ignition system according to claim 5, wherein said radiation sensitive device is a photo-transistor.

8. An electronic ignition system according to claim 1, additionally including means for generating a first series of square wave voltage pulses in synchronism with the engine revolutions, to provide a series of alternate first and second pre-determined voltage levels; means for generating a second series of square wave voltage pulses at a frequency greatly in excess of the first series; means for counting a given number of the second series of voltage pulses from a given point in relation to the first series of voltage pulses; means for producing an output at said first voltage level from said counting means after said count has been completed; means for detecting the presence of both a signal at said first level from the first pulse generating means, and the counting means, in order to bring about the initiation of the spark, the extinguishing of the spark being effected when the signal from the first generating means changes to the opposite level; and means for varying the count of the counting means in accordance with the crank-shaft position of the sensed pre-determined pressure on the pressure rise curve if this deviates from the pre-determined crank-shaft position.

9. An electronic ignition system according to claim 8, wherein the counting means starts to count from a point near the position of maximum advance.

10. An electronic ignition system according to claim 8, wherein the counting means is an electronic counter.

11. An electronic ignition system according to claim 8, additionally including an AND gate receiving a signal derived from the means for sensing the pre-determined pressure on the pressure rise curve occuring during the second stage of the combustion process, and the output from the means for generating the first series of square wave voltage pulses, said AND gate providing a logical output to either increase or decrease the count of the counting means.

12. An electronic ignition system according to claim 8, additionally including a comparator receiving a signal derived from the means for sensing the pre-determined pressure on the pressure rise curve occuring during the second stage of the combustion process, and a signal derived from one edge of the square waveform generated by the first generating means, said comparator comparing the relative positions of said two signals and effecting either an increase or decrease in the count of the counting means if the two signals are not coincident.

13. An electronic ignition system according to claim 12, additionally including the series combination of: a differentiator; a limiter circuit; an inverter; and a frequency divider located between the output of the first square waveform voltage generating means and the comparator in order to generate said signal derived from one edge of the square waveform of the first generating means.

14. An electronic ignition system according to claim 13, wherein the frequency divider is synchronized with the output from the output of the means for sensing the pre-determined pressure on the pressure rise curve occuring during the second stage of combustion.

15. An electronic ignition system according to claim 1, additionally including: means for generating a series of square wave voltage pulses whose mark space ratio is variable for the purpose of advancing or retarding the ignition; means for varying the mark space ratio of the generated square wave voltage pulses in response to engine requirements; means for deriving a signal from said sensed pre-determined pressure; and means operative from a digital timing comparison between the occurrence of said derived signal and said fixed predetermined crank-shaft position as determined by an edge of the square voltage pulses to vary the mark space ratio of said voltage pulses and hence the ignition timing so maintaining coincidence between said derived signal and said edge of the square wave

voltage pulses.

16. An electronic ignition system according to claim 15, wherein the means for varying the mark-space ratio include an apertured disc driven in synchronism with the crank-shaft of the engine, said apertures being equi-spaced around the disc, an infra-red radiation source and a detector mounted on either side of the disc for movement relative thereto, a first operative edge of each aperture being aligned in the direction of movement of said radiation source and detector, whilst a second operative edge is inclined relative thereto in order to achieve said advance or retard of the ignition timing, and mechanical means for moving said radiation source and detector in accordance with engine requirements.

17. An electronic ignition system according to claim 16, wherein said mechanical means includes a diaphragm actuated from the partial vacuum in the inlet manifold of the engine against the action of a spring, said diaphragm being coupled to said radiation source and detector for movement thereof relative to the disc, and a solenoid actuated from the result of said timing comparison for bleeding in air to partially relax said diaphragm against the pull of the partial vacuum.

18. An electronic ignition system according to claim 15, wherein the means for deriving a signal from the second stage of combustion is an electro-mechanical transducer device which is located in the wall of the cylinder, above the level of the top of the piston at top dead centre.

19. An electronic ignition system according to claim 18, wherein said electro-mechanical transducer device is a piezo-electric detector.

20. An electronic ignition system according to claim 16, wherein said first operative edge of each aperture is radial with respect to the centre of the disc, whilst the second operator edge is inclined to the radial direction of the disc, the infra-red radiation source and detector being coupled to said mechanical means so as to be movable in a radial direction with respect to the centre of the disc.

21. An electronic ignition system according to claim 16, wherein said mechanical means includes an engine vacuum device coupled to said radiation source and detector, the movement of said engine vacuum device being controlled by a solenoid which on operation from the result of the timing comparison bleeds in air to maintain the desired timing position.

22. An electronic ignition system according to claim 15, wherein the signal derived from the second stage of combustion is a digital signal which is fed to the same input of an electronic device controlling said operative means as the said square wave voltage pulses, thereby performing said timing comparison digitally.

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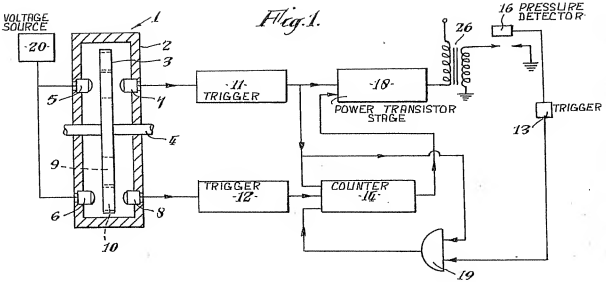

Fig. 1.

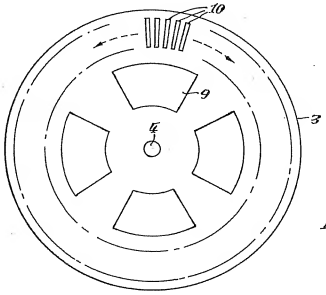

Fig. 2.

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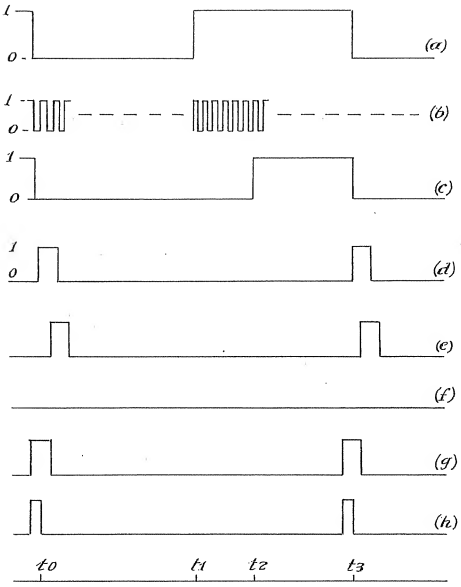

Fig. 3.

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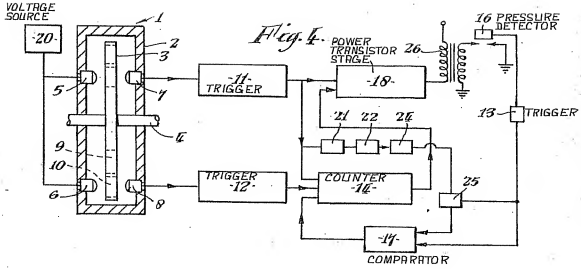

Fig. 4.

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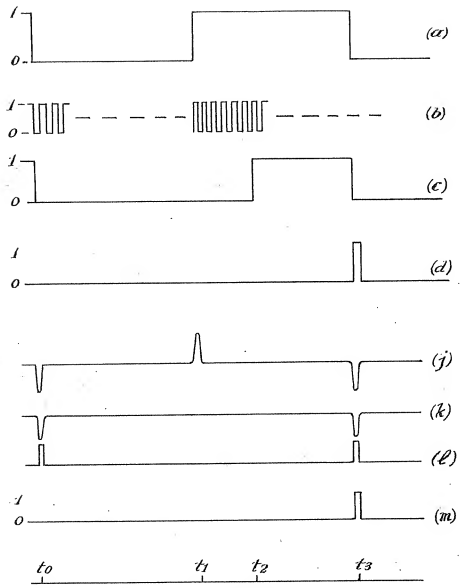

Fig. 5.

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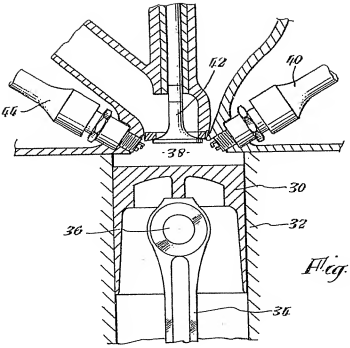

Fig. 6.

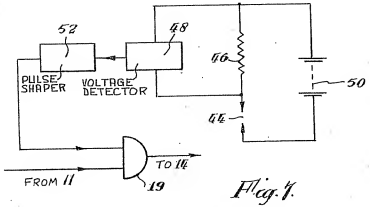

Fig. 7.

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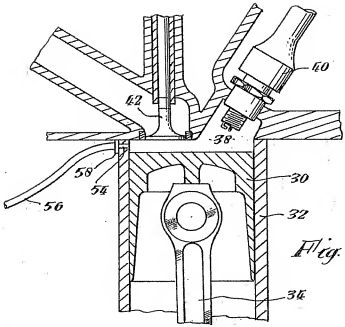

Fig. 8.

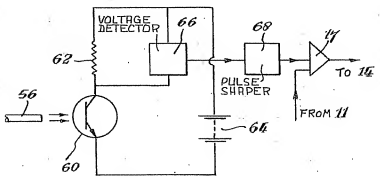

Fig. 9.

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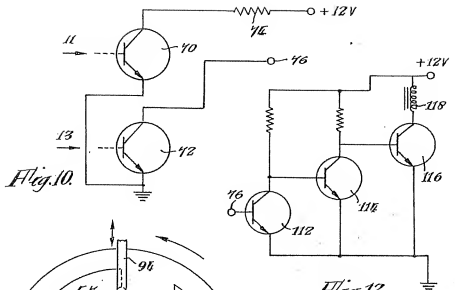

Fig. 10.

Fig. 13.

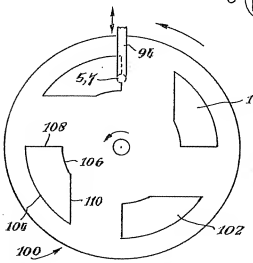

Fig. 12.

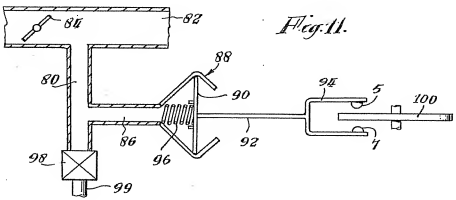

Fig. 11.

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